



Nano- Biotechnology Education and Applied Research

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Outline

- Education and Nano-Biotechnology
 - Hands on experimentations
 - Class development (minor in Biotechnology)
 - Introduction to Nanotechnology
 - Nano-Biotechnology
- Applied Research and Nanotechnology
 - E. coli O157:H7 biosensor development
 - Glucose Nanobiosensor
 - Photovoltaic Cells

Background

- Lincoln University
 - 1890 founded in 1866
 - HBCU
 - 3800 students
 - Agriculture department, Life and Physical Sciences
 - Educational focus - undergraduate
- Students
 - Biotechnology course
 - Minor in Biotechnology

Objectives

- To introduce Nano-Biotechnology course as continuation and advancement to Biotechnology course
- To allow students to gain experience through HOE in Nanotechnology
- To allow students to gain design knowledge in fabricating optical Nano-biosensor
- To enhance student recruitment and retention

Objectives

➤ **Intellectual Merit**

- Improve minor program by adding Nanotechnology
- Introduction to Nanotechnology and Nano-Biotechnology through hands on experimentation
- Recruiting undergraduate from different disciplines
- Collaboration

➤ **Broader Impact**

- Online class
- Retention and graduate school
- Applied and transformative research
- Experimental design and modeling
- Copy write and provisional patent
- View of students

Year 1 Tasks

- Establish collaboration with University of Missouri-Columbia
- Develop and perform experiments
- Develop course syllabi for Nanotechnology
- Identify and recruit students
- Development of optical Nano-biosensor

Introduction to Nanotechnology

➤ Nanotechnology General Information

- What is Nano? Nano vs. Micro
- Properties
- Fabrication
- Characterization
- Application

➤ Nanotechnology Properties

- Self-Assembly
- Magnetic-Fluids
- Silver Nanoparticles (SNP)
- Super Hydrophobic Surfaces

Introduction to Nanotechnology

- **Nanotechnology Fabrication**
 - Silver Nanoparticles (SNP)
 - Photolithography
- **Nanotechnology Characterization**
 - AFM-Microscope
 - SEM-Microscope
- **Nanotechnology Application**
 - Optical biosensor
 - Solar-Cell

Introduction to Nanotechnology

- Tools for students
 - Instruction manual
 - Video
 - Website
 - All experiments online
 - U-tube
 - Training of undergraduate students
- High school participation
 - Undergraduate to present work
- Collaborate with Oak Ridge national lab
- Collaborate with biotech companies

Results

➤ Education

- New class for undergraduate with 16 students
- 5 HOE
- 3 retained as physics major
- 2 graduate school
- New group to train

➤ Research

- Encapsulation of RBCs (NIH)
- MEMS biosensor for detecting bacteria (NSF)
- Photovoltaic Cell (NASA)

Applied Research and Nanotechnology

- Back ground in Electrical and Computer Engineering including Biomedical and Biological Engineering
 - Sensor and Biosensor development
- Detection system for E. coli O157:H7 to include a 3-D MEMS platform
- Qualitative and quantitative sensing mechanisms
 - Technical components
 - Educational components

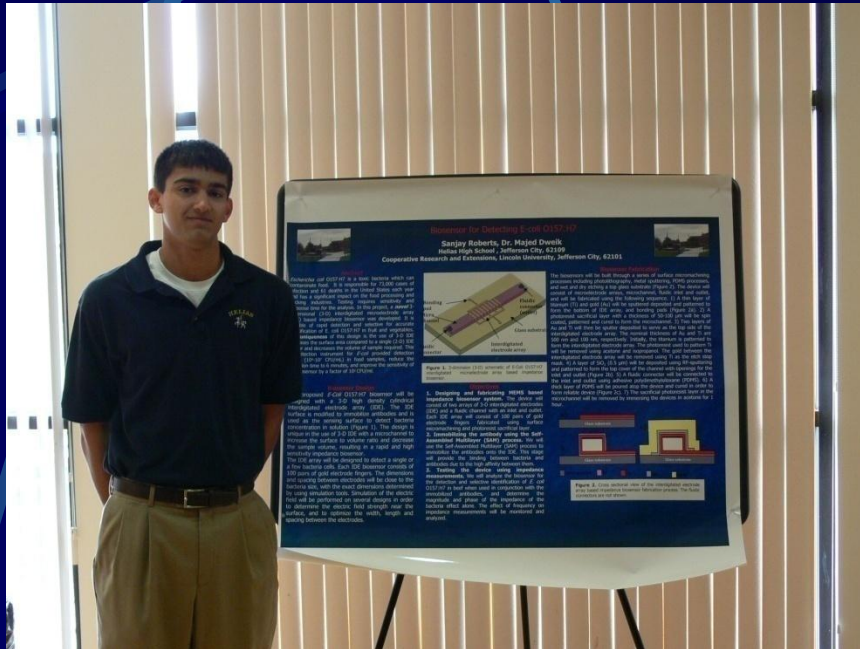
Applied Research and Nanotechnology

- Technical components (collaboration with University of Missouri-Columbia)
 - Lincoln University
 - COMSOL software to model and design biosensor
 - Optical detection of E. coli by using antibodies to establish binding affinity
 - Immobilization process on 2-D platforms fabricated at collaborator lab
 - Impedance measurements
 - 3-D platforms to use

Applied Research and Nanotechnology

- Educational component
 - Undergraduate training on different aspect of fabrication
 - Platform fabrication (MEMS)
 - Modeling and design by using software
 - Incubation and growing of lab grade E. coli
 - Training on various equipments and techniques in the lab
 - Chemical reagents preparation and functions
 - Measurement of concentration with different techniques
 - Optical measurement equipments
 - Immobilization technique
 - Results and analysis
 - Dissemination of work into oral and or poster presentation
 - Undergraduate to present to high school students

Applied Research and Nanotechnology

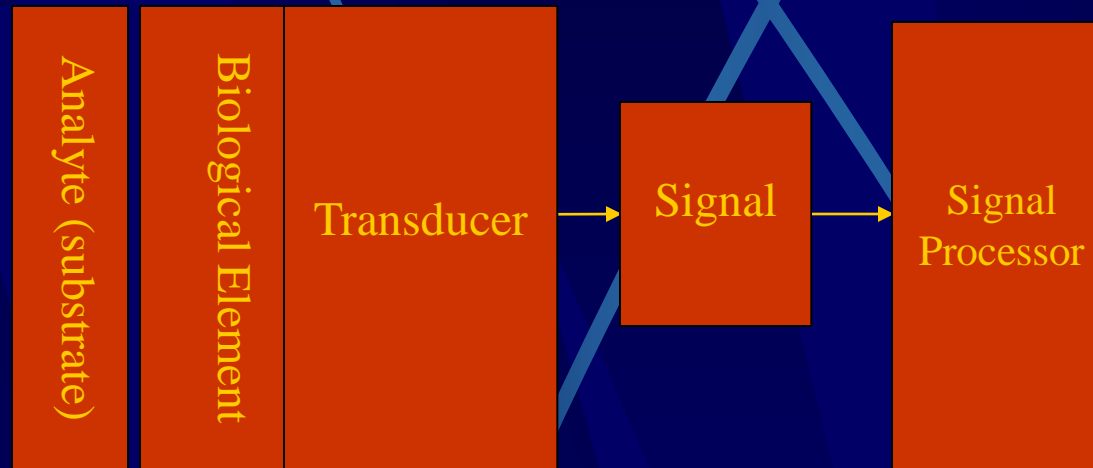


Sanjay Roberts. A junior from Helias High School in Jefferson City

Applied Research and Nanotechnology

- Glucose Nanobiosensor Encapsulated in Erythrocytes (NIH)
 - Training and educational grant

Optical Biosensor



- Optical
 - Fluorescence
 - FRET based sensor
 - Ratio metric technique
- Biosensor
 - Enzyme (GOx, GDH)
 - Protein (Con A, GBP)

Nanoprobes Encapsulation

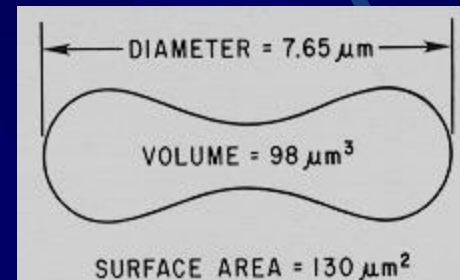
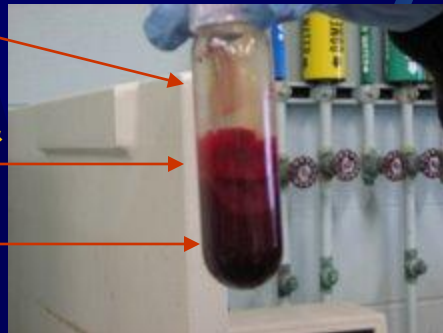
- Red Blood Cells (RBCs)
 - General information
 - Shape, size, quantity(5mil/ul), life time(120days), main job
 - Features
 - Shield
 - Glucose carrier
 - No nucleus
 - 120 days



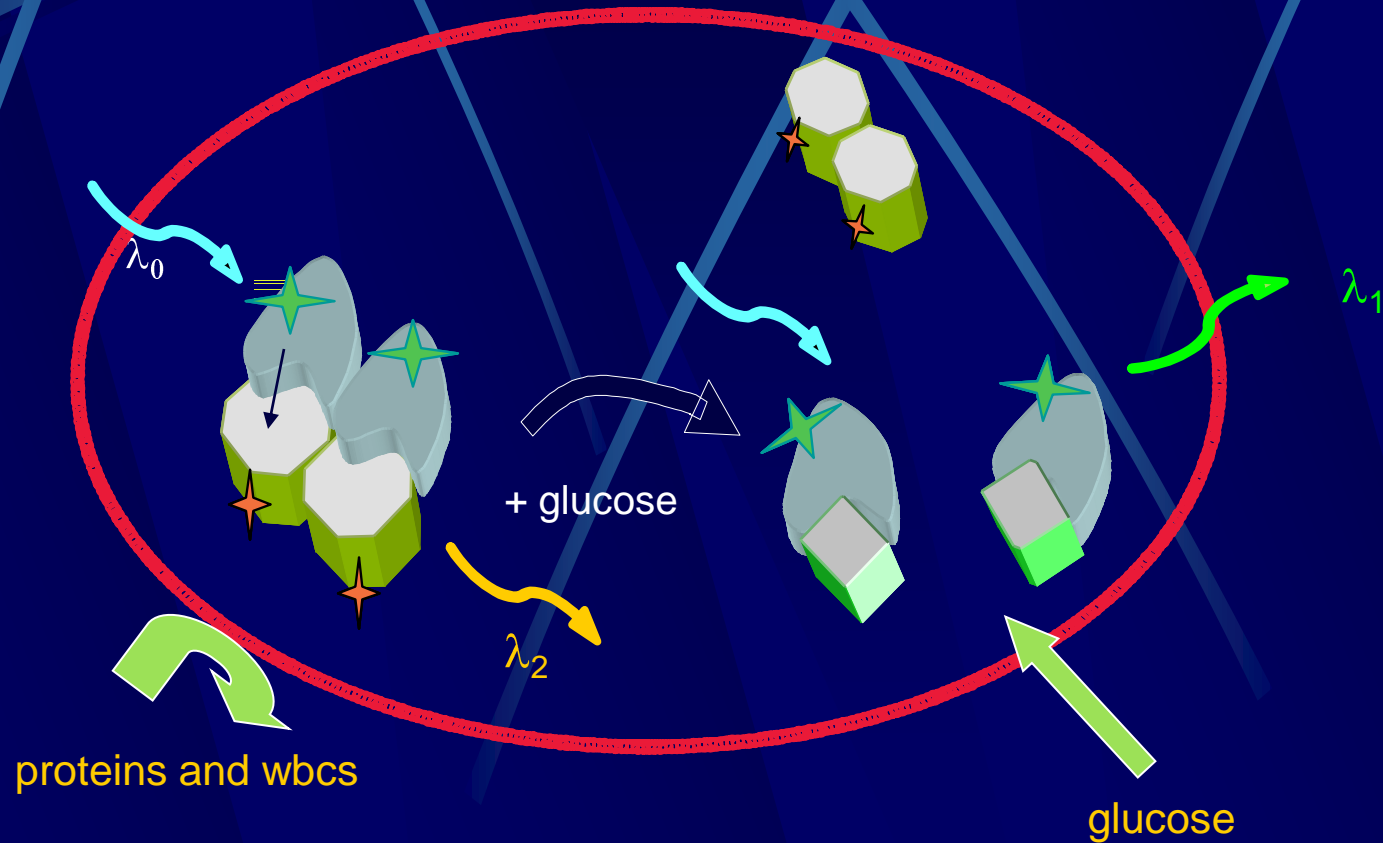
Plasma

Platelets &
WBCs

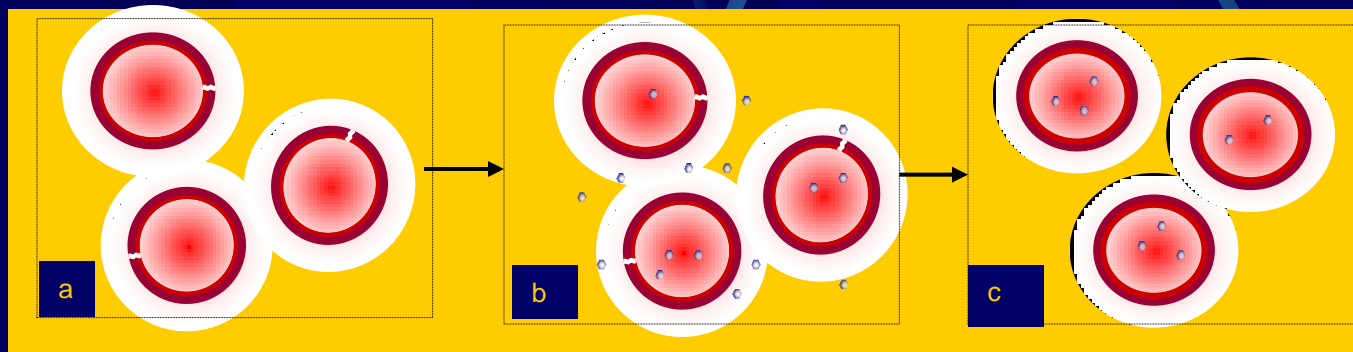
RBCs



Schematic of Intracellular Sensor



Nanoprobes Encapsulation



Hypo-osmotic dialysis technique

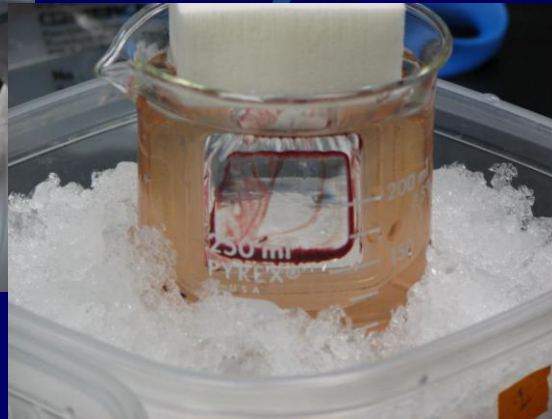
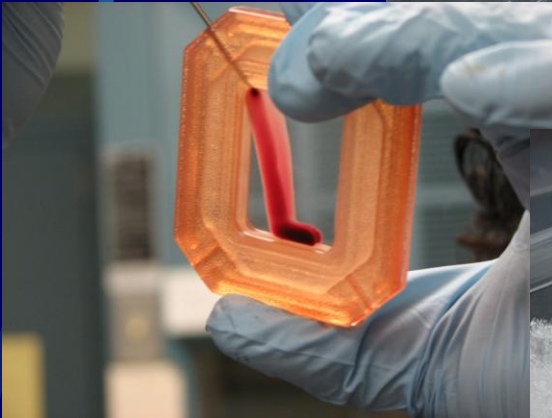
Method of Encapsulation

- Phosphate buffer
- Dialysis buffer
- RBCs separation
- Nanoprobes for encapsulation



Method of Encapsulation

Dialyzing

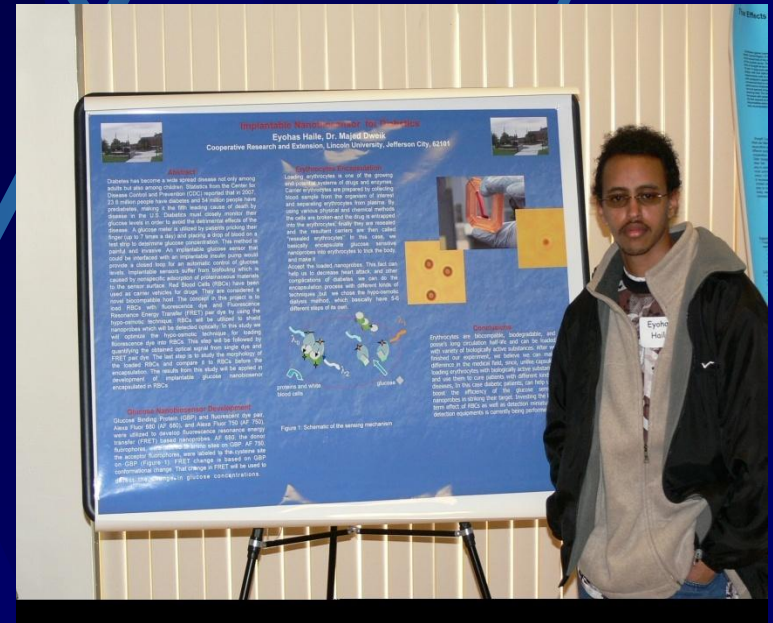


Incubation



Applied Research and Nanotechnology

Eyohas Youssef. A freshman at Lincoln University pursuing premed.



Year 2 Tasks

- Faculty teach re-designed course
- Continue students training at UMC
- Collect and begin analysis of data on student improvement
- Recruit and identify student
- Development of applied research

Acknowledgments

- USDA-CSREES
- UMC
- Helias high school

Thank You

